and ever-increasing share in shaping the destinies of his country in regard to science and higher education, Kikuchi had scant leisure for mathematical research. His chief work as an investigator was historical, and he contributed a number of papers to the Tokyo Mathematical Society on the mathematics of the old Japanese school. He also wrote a text-book on elementary geometry for use in Japanese schools and colleges. Of far greater moment to his country, however, was his disinterested devotion to the cause of the higher learning in science and morals. It was for this that he was created a Baron in 1902. His successive honours came to him simply because he was indispensable to his country and to his sovereign. But to the end he retained all the characteristics which endeared him to us—modest, courteous, gracious, always acting from the highest motives, strong in purpose yet never aggressive, and combining in a singular degree the finest traits of the Japanese Samurai with the best qualities of the youth of England. At the most impressionable time of life Kikuchi lived under the full influence of the best culture our island kingdom can offer; and we may be pardoned for regarding his preeminent success as in no small measure due to his unconscious training in a land where liberty, individuality, and zeal for the common good are of the very air we breathe. C. G. KNOTT.

NOTES.

IN three Chadwick public lectures on the part of hygiene in the European war Dr. Woods Hutchinson gave some noteworthy facts in connection with the progress of military hygiene. The present world-struggle is probably one of the least deadly ever fought in proportion to the numbers engaged. Less than 5 per cent. of the wastage of former wars was due to wounds or deaths in battle; the other 95 per cent. was caused by disease. In the armies themselves the ratio was six to nine deaths by disease to one in battle or from wounds. In this war the ratio is sixteen deaths in battle to one from disease. Of the wounded who survive six hours 90 per cent. recover, of those who reach the field hospitals 95 per cent. recover, and of those who arrive at the base hospitals 98 per cent. get well. Barely 5 per cent. of the wounded are crippled or permanently disabled. There is good reason to believe that the death-rate of this war does not exceed 5 per cent. per annum. The subjects of food and diseases of an army were also discussed. The superb health and vigour of our armies on the Western front are due largely to the rich and abundant supply of food. These armies had less sickness and fewer deaths from pneumonia and other diseases than they used to have in barracks in times of peace. The old plagues of army camps—cholera, Black Death, and spotted typhus—all lifted their heads in Italy, in Serbia, and in Russia, but all were promptly stamped out by modern sanitary science. The total number of cases of serious or lasting "shell-shock," so called, and mental disturbance, during 1916 in the trenches in France, was 2600, fewer than one per 1000 of the armies in the field, and fewer than half of the ordinary insanity rate in men of military ages in times of peace. Modern nerves had stood the fearful strain of this war superbly.

AN appeal to the Local Government Board to take action towards establishing a Ministry of Health was made by a deputation from the Standing Joint Committee of Industrial Women's Organisations which waited on the President of the Board (Mr. Hayes Fisher) on November 16. Mr. Stephen Walsh (Parliamentary Secretary) was also present. The organisations represented were the Women's Trade Union League, the Women's Co-operative Guild, the Women's Labour League, the National Federation of Women Workers, and the Railway Women's Guild. It was urged that the new department's basis must be the public health side of the Local Government Board, and that it would not serve merely to re-name that Board the Ministry of Health. Such a Ministry should take into partnership the National Insurance Commissioners, and it was absolutely essential that it should be dissociated from the old Poor Law system. On the same day Mr. Hayes Fisher received a deputation on the same subject from the Society of Medical Officers of Health, and the Association of County Medical Officers of Health. Mr. Hayes Fisher, in replying, said that the Local Government Board was asking for a Bill that would enable local authorities in England and Wales to do all the things that were being asked of the new Ministry of Health. This Bill had not been able to go any further because the National Insurance Commissioners were asking for similar powers in respect of infant welfare and maternity. Whoever might obtain the powers, the responsibility for carrying them out would rest with the medical officers of health.

THE stress of war has brought success sooner than was anticipated to the efforts which have been made for many years to secure the establishment of a National Seed-testing Station for England and Wales. Scotland and Ireland have for several years had the advantage of such stations, and now England has at last fallen into line. The new station, which is associated with the Food Production Department of the Board of Agriculture, was formally opened on November 14 by the President of the Board, whilst the same evening the text of the Testing of Seeds Order was issued by the Ministry of Food. This Order becomes operative on January 1, 1918, and institutes a close control over the sale of the more important seeds The testing of samples in connection with the Order will be carried out in the new station, which is fully equipped for the purpose, and will further undertake the testing of seeds for farmers and allotment-holders at a nominal fee of threepence per sample, and for seed traders at half a crown per sample. The station is located at 70 Victoria Street, S.W.1, and is under the direction of Mr. R. G. Stapledon, advisory botanist of University College, Aberystwyth, who for some time has been actively associated with the work of the Food Production Department at headquarters. In declaring the station open, Mr. Prothero expressed the hope that in years to come there would be associated with it an Institute of Applied Botany, which would be of great service to agriculture.

AN interesting and important report of the Nitrate Supply Committee (appointed by the United States Secretary of War) is summarised in *Science* for September 14. The chief recommendations made are as follows:—That out of the 4,000,000*l*. nitrate supply appropriation the following sums be made available for the purposes indicated:—(1) 600,000*l*. to be used in building a synthetic ammonia plant (best in south-west Virginia or a contiguous region), contingent upon the completion of satisfactory negotiations with the General Chemical Co. for the rights to use its synthetic ammonia process; (2) 120,000*l*. to be placed at the disposal of the War Department for building a plant for the oxidation of ammonia to nitric acid and concentrating the latter; (3) 40,000*l*. to be allotted to experimentation in the industrial development of the Bucher process for the production of sodium cyanide and ammonia, contingent upon a satisfactory arrangement being made with the Nitrogen Products Co.; (4) 20,000*l.* to be made available for the active prosecution of investigations into processes for the industrial production of such nitrogen compounds as are required in the manufacture of explosives and fertilisers. The committee further recommends that the War Department proceed with the construction of the plants mentioned under (1) and (2) above at the earliest practicable date, that the Government promote the installation of by-product coke-ovens in order to increase the production of ammonia and toluol, and that a decision regarding the more extensive installation of nitrogen processes be postponed until the plants now recommended are in operation. The committee is of opinion that the immediate accumulation and permanent maintenance of a reserve of Chile saltpetre of not fewer than 500,000 tons is a measure urgently necessary.

We learn from *Science* that upon the recommendation of the U.S. National Research Council Dr. A. Trowbridge, of Princeton University, and Prof. T. Lyman, of Harvard University, have received commissions in the Signal Corps, U.S.A., for work in sound-ranging. They have sailed for France to investigate conditions at the front in this subject. The sound-ranging service which will be developed under their direction will utilise in the near future more than fifty men. A meteorological service has been organised under the Signal Corps, U.S.A., in which about one hundred physicists and engineers will be engaged in aerological observational work under the direction of Dr. W. H. Blair, of the U.S. Weather Bureau, who has sailed for France to investigate conditions abroad. Forecasting work for the American Expeditionary Force in France will be in charge of Mr. E. H. Bowie, of the U.S. Weather Bureau. Prof. C. E. Mendenhall, of the University of Wisconsin, has been placed in charge of the development of aeronautical instruments. All the work of these services, sound-ranging, meteorology, and aeronautical instruments, is included within the scope of the Science and Research Division of the Signal Corps, which, in accordance with a recent order of the chief signal officer, has been established and placed under the direction of the National Research Council, of which Major R. A. Millikan is the executive officer. The functions of this division of the Signal Corps are twofold, namely: (1) to furnish *personnel* of the research sort to the other divisions when the situation warrants the assignment of men of this type to these divisions, and (2) to have a *personnel* of its own which maintains intimate contact with all research and development work in other divisions, and distributes research problems to university, industrial, and governmental research laboratories with which it is associated. Similar, though in some cases less formal, relations have been established with other technical bureaux of the War and Navy Departments. Upon request of the French High Commission a number of American physicists and chemists are being sent to France to assist in various war problems in which technically trained men are needed. Upon the recommendation of the National Research Council Prof. R. W. Wood, of Johns Hopkins University, Prof. E. Bartow, of the University of Illinois, Prof. R. Stevenson, of the College of the City of New York, and other men of science are receiving commissions in this connection, and a number of them have already sailed for France.

The Committee of the Loutreuil Foundation has reported to the Paris Academy of Sciences (*Comptes rendus*, October 22) that it has recommended the following grants:—The National Natural History Museum, 3000 francs to Prof. Louis Roule for assistance in his researches on the migrations of the Salmonidæ. Central Council of the Observatories: 8000 francs to the Observatory of Lyons for the installation of a telephone line; 1500 francs to Henry Bourget, director of the Marseilles Observatory, for assisting in the publication of the *Journal des Observateurs*. Ecole Polytechnique; 1000 francs to Prof. A. Colson for his physico-chemical researches on the theory of solutions. National Veterinary College of Lyons: 5000 francs for the installation of radiological apparatus; 350 francs to Prof. Charles Porcher for the purchase of apparatus for researches on milk. National Veterinary College of Toulouse: 5000 francs for the purchase of a projection apparatus capable of utilising kinematographic films. Conservatoire des Arts et Métiers: 5000 francs to Prof. Léon Guillet for the organisation of a metallographic laboratory. In reply to demands addressed direct: 5000 francs to Charles Alluaud and R. Jeannel; 1000 francs to Henri Blondel; 5000 francs to the Institute of Hydrology and Climatology; 2000 francs to R. Ledoux-Lebard and A. Dauvillier for their X-ray researches; 2000 francs to A. Paillot, for the purchase of material required for bacteriological researches; 1000 francs to J. de Thézac; and 3000 francs to Albert Portevin and Marcel Garvin. The grants proposed amount to 47,850 francs, and the committee considers it necessary to carry forward a large balance, in view of probable demands at the close of the war.

Prof. J. A. Fleming will deliver a Christmas course of six illustrated lectures (adapted to a juvenile auditory) at the Royal Institution, on "Our Useful Servants: Magnetism and Electricity."

A general meeting of the Geological Physics Society will be held in the rooms of the Geological Society, Burlington House, on Wednesday, November 28, at 3.30 p.m., at which a lecture will be delivered by Mr. C. Carus-Wilson on "Theories and Problems relating to Musical Sands," illustrated by experiments. The meeting will be open to visitors.

The Thomas Hawksley lecture, 1917, of the Institution of Mechanical Engineers will be delivered at six o'clock on Friday, November 30, in the hall of the Institution of Civil Engineers, Great George Street, Westminster, by Capt. H. R. Sankey, who will take as his subject "Heat Engines." An invitation is given to visitors.

At a meeting of the Chemical Society held on November 15 the following exhibits were shown:—Laboratory glass apparatus and specimens of chemicals, by Messrs. Baird and Tatlock; laboratory ware, by Messrs. Doulton and Co., and by the Royal Worcester Porcelain Co.; specimens of dyes used in the clothing of the Armies of the Allies, and medicinal agents and antiseptics, by Messrs. Levinstein, Ltd.; balances and weights, by Mr. L. Oertling; and laboratory glass apparatus, by Messrs. Wood Bros. Glass Co., Ltd.

As the subject of the metric system was very fully discussed at the Institution of Civil Engineers in the early part of the year, especially from the point of view of the relative merits of that system and the British, it may be well to state that the main object of the discussion to be held at the Institution of Electrical Engineers on December 13 is to consider the effect on the British electrical trade of the introduction of the metric system at the present time, especially in those markets in which the British system is at present in vogue, with the view of determining whether the compulsory introduction of metrical measures should be pressed for or resisted. It is hoped that it may be found possible to take steps after the discussion to obtain some authoritative pronouncement on the matter from the trade as a whole that will put an end to the present hesitating and unsatisfactory attitude towards the question.

We regret to record the death of Mr. Wilson Noble on October 31, at sixty-two years of age. Mr. Wilson Noble was a fellow of Trinity College, Cambridge. From 1886 to 1895 he was Conservative M.P. for Hastings. He devoted much of his time to electrical investigations, particularly in connection with X-rays, and having a very fully equipped laboratory was able to render great service in the medical applications of radiography in the early days of the discovery. He held the position of president of the Röntgen Society in 1900, and was the author of some important papers on X-ray technique.

News has been received of the sudden death last week, at fifty-nine years of age, of Prof. Emile Durkheim, the distinguished philosopher and sociologist, editor of the *Année Sociologique*, and professor of pedagogics at the Sorbonne. The loss of his only son, a young philosopher of great promise, in the fighting at Salonica at the end of 1915, and a long uncertainty as to his fate, had visibly affected Prof. Durkheim's health, but he was able to continue his courses to the end of the scholastic year. In November, 1916, a nervous breakdown obliged him to discontinue his work, and in spite of temporary improvements he never recovered.

2nd Lieut. L. P. Sidney, whose death, at twenty-four years of age, is reported in the *Times*, was an observer in the Royal Flying Corps. He was the son of Mr. L. P. Sidney, assistant secretary of the Iron and Steel Institute, and studied for a time at the National Physical Laboratory, Teddington, in the engineering department under Dr. Stanton, and in the metallurgical department under Dr. Rosenhain. On leaving Teddington he spent a year in iron and steel analysis with Mr. F. W. Harbord, and when the war broke out he was in the service of Messrs. Bell Brothers, Middlesbrough, as metallurgist.

We learn from *Science* that Mr. J. Y. Bergen, author of several well-known text-books of botany and physics, died at his home in Cambridge, Mass., on October 10, at sixty-six years of age. In 1887 Mr. Bergen became teacher of physics in the Boston Latin School, and later for many years he was instructor in biology in the Boston English High School. In collaboration with Prof. E. H. Hall, of Harvard University, he was the author of "A Text-book of Physics," which has passed through several editions. He was also the author of "Elements of Botany," "Essentials of Botany," and "Foundations of Botany," including a condensed flora for school use. Other successful text-books with special adaptation for schools of particular grades of scientific equipment were prepared by Mr. Bergen in collaboration with Dr. O. W. Caldwell and Prof. B. M. Davis.

The inaugural lecture in connection with the George Herdman chair of geology at the University of Liverpool was delivered by Prof. P. G. H. Boswell on Friday last, November 16. In a short introductory address, the Vice-Chancellor (Sir Alfred Dale), who presided, remarked that many of the University chairs were memorials of those who had done their work or whose work was nearly done, but the chair they were now inaugurating was one established in memory of youth, and of a work that was just begun. It had been established by Prof. and Mrs. Herdman in memory of their son, George Andrew Herdman, who fell rather more than a year and a half ago in France. He was young, and an undergraduate at Cambridge. But he had already given something more than mere promise, and older men who knew him regarded him as one who not only would maintain, but also might possibly increase, the honours he had inherited with his name.—The subject of Prof. Boswell's lecture was "Sands: considered Geologically and Industrially under War Conditions."

Sir W. T. Thiselton-Dyer has presented to the library of the Royal Botanic Gardens, Kew, a collection of about a hundred personal letters addressed to him by Charles Darwin between the years 1873 and 1881. Those of more general interest have been already published. In one he writes, "It is a dreadful evil to be so ignorant of botany as I am," and many of them contain allusions to experiments and discoveries of the utmost interest. These letters constitute a very valuable addition to the now extensive collection of original documents to the Kew Library.

We learn from *Kew Bulletin*, No. 6, that the island of Ascension has suddenly been clothed with verdure, a grass, *Enneapogon mollis*, having appeared in great abundance on the lower parts of the island. The account is illustrated by a photograph showing men cutting a luxuriant crop of the grass, which has converted what Sir Joseph Hooker described as a "scorched mass of volcanic matter, in part resembling bottle-glass and in part coke and cinders," into a comparative paradise. The grass, which is apparently an annual, has not been reported from the island before, but is a native of tropical Africa, and seeds may have reached the island through the agency of birds, or have been wind-borne. It appeared after some good showers, rain being of very rare occurrence in Ascension.

During the present war more use has been made of electrical treatment than at any previous time. Cases that are seldom or never seen in times of peace, such as shell-shock and trench-foot, are receiving their trial of electric treatment, as well as neurasthenia and various neuroses, so that more detailed information of the value of this form of treatment will be obtained. Cases of nerve injury are also numerous, and much experience is being obtained of the uses of electricity in their diagnosis and treatment. The *Archives of Radiology and Electrotherapy* proposes to publish reports from the electrical departments of various war hospitals, and in the October number (vol. xxii., No. 5) an account is given by Lieut. Burke of that of the Horton War Hospital, Epsom. The report of the Radium Institute of work from January, 1915, to December, 1916, is also included. Of 580 cases of cancerous disease treated (excluding rodent ulcer) twenty-six were apparently cured.

The West Indian colonies, in common with the rest of the world, have their bread problem. How this is to be met is the subject of an official inquiry, and an interim report of the British Guiana Flour Substitutes Committee, published in the Bulletin of the Department of Agriculture, Trinidad and Tobago (vol. xvi., part 2) indicates the lines upon which action can be most usefully taken. Analyses collated by the committee show that the products of tropical origin which most nearly approach wheat flour in food value are rice, guinea-corn, and maize. These materials can be employed alone only in the preparation of cakes. Without wheat flour they do not give a satisfactory bread. Other products of relatively higher starch content which are of local origin, *e.g.* cassava, sweet potatoes, tannias, and eddoes, can also be employed in this way, but they yield an article of lower food value and wider nutrient ratio. It is possible, however, by the addition of a proportion of meal obtainable from locally grown pulses, *e.g.* pigeon-peas, black-eye peas, lima, and bonavist beans, to bring the nutrient ratio of these more starchy products up to the desired standard. Action upon these lines is recommended, and a proposal is put forward for the establishment of a factory, or factories, for converting the locally grown raw materials into non-perishable and marketable products. The same number of the bulletin contains also papers by Mr. R. O. Williams and Mr. H. Meaden, in which more detailed information on the various suggested flour substitutes is given.

SINCE the war began it has become apparent that the resources of the Empire in food and raw materials have not hitherto been used to meet the needs of the Empire itself to anything like the extent that is desirable. Rice is a striking example of this state of things. Thus India, which produces (principally from Burma) about 40 per cent. of the world's exportable surplus of rice, distributed its exports in 1913–14 in the following proportions: to British countries 42·6 per cent., to foreign countries 57·4 per cent. The gross imports into the British Empire were little less than the total exports of rice from India, so that it would be quite possible to find a market within the Empire for nearly all the rice India can spare for export. While this country occupied a relatively unimportant position as a direct importer of rice from India, it imported considerable quantities of rice from Holland and Germany, which had been first exported from India to those countries, and, after being milled and polished there, had been re-exported to England. It is clear that there is much leeway to make up in the way of developing inter-Imperial trade in food and raw materials. In the new number of the Bulletin of the Imperial Institute is published an exhaustive article on the "Production and Uses of Rice" (British literature on which subject has hitherto been practically non-existent), which, it is hoped, will assist in that direction. It gives precise information as to the present production of rice throughout the world and the demand for this grain within the Empire, the general tendencies of the trade, the directions in which markets should be sought, and various uses to which rice is freely applied in certain countries, though not, as yet, within the Empire.

IN a paper on the testing and standardisation of motor fuel, read at the Institution of Petroleum Technologists on October 16, Mr. E. L. Lomax described an improvement of the Engler process for determining the degree of volatility of motor fuels. The method consists essentially in the adaptation of a jacketed dephlegmator column to the usual apparatus, and is designed to give results similar to those obtained by the original method of distillation, but with greater rapidity and easier manipulation. In connection with this subject attention is directed to the gradual change in the composition of motor-spirits corresponding with the development of motor engines during the last decade. Whereas formerly the average proportion of these spirits volatile below 100° C. was about 60 to 70 per cent., it is now only about 20 to 40 per cent., with a correspondingly greater proportion of higher boiling hydrocarbons. This is important, since it means that motor engines have been so improved that they can utilise more of the heavier fractions of petroleum than formerly; the present-day automobile engine will run quite well on spirit which would have given much trouble with the engine of earlier days. It is for motor engineers to see that the engine of the future will run well on even a less volatile mixture than that now employed. The world's supply of petroleum products suitable for use in internal-combustion engines is strictly limited, and development on the lines indicated is one of the means by which the petroleum industry may be enabled to meet the growing demands. At the present time it is a waste of valuable products to use spirit containing an unduly large percentage of the more volatile compounds for road and water vehicles, as these light fractions assist the vaporisation of heavier hydrocarbons which are not by themselves satisfactory fuels for internal-combustion engines, but which can be used for the purpose when mixed with the lighter fractions. Thus utilised, they serve greatly to increase the available supplies of motor fuel.

ALTHOUGH the calls made on the services of the National Physical Laboratory for work connected with the war during the past two years have been exceptionally heavy, the appearance of vol. xiii. of the Collected Researches of the Laboratory shows that research work has not been neglected. The volume extends to 300 pages, and includes researches from the Froude tank, the engineering, metallurgical, optical, and magnetic departments. More than half the total number deal with optical questions of vital importance to the instrument-maker. Some of these describe new methods which instrument-makers have already adopted, while others provide material for future use. A paper on tests of fuel oils made for the Royal Commission on Oil Fuels by Messrs. Pannel and Higgins appears not to have been published previously. It deals with the flow of Mexican, Texas, Trinidad, and Scotch shale oils, and of mixtures of them through pipes of various diameters, and shows that the pressure head necessary to give a prescribed flow can be determined by the expression which has been shown to hold for the flow of water or air through pipes of different diameters. The viscosities, densities, and flash points of the above oils, and of Borneo, Persian, and Kimmeridge shale oils, and of their mixtures, were also investigated, and the advantages of certain mixtures are pointed out.

La Nature for October 27 gives some particulars of the Institute of Applied Hydraulics which has recently been inaugurated by the University of Padua. The new institute is situate at Stra, on the Padua-Venice tram route. A villa has been taken and converted into laboratories, which are provided with the usual equipment, lecture-rooms, etc. Facing the building is a long canal, which has been transformed into an experimental tank, along which runs the electrically driven carriage. The tank is 200 metres long, 10·75 metres wide at the surface, and 3·5 metres deep. Researches have already been carried out in the tank on the flow of water in tubes of various cross-sections and diameters under constant or slowly varying pressures, the motion of water in forced conduits such as are used in hydraulic plants, and so on. A tower specially erected near the main building produces a head of water for experimental purposes, *e.g.* determining the influence of change of shape of pipe and the nature of its walls, and the strength of materials used in structural work. Investigations are at present in hand on the value of the instruments used for measuring flow, such as Pitot tubes and the Woltmann mill, and the influence of their length, depth of immersion, etc., on the accuracy of measurement. The new Hydro-technical Institute will publish a bulletin periodically setting forth researches undertaken, together with the results attained. The institute will also keep in close touch with the Hydrographic Department at Venice, and thus be able to supply any information required bearing on the protection of that city from floods and the study of the lagoons along the Adriatic.

THE whirling of shafts has occupied the attention of many engineers during recent years, and a series of articles by Mr. H. A. Webb, which appears in *Engineer-*

ing for November 2, 9, and 16, will be read with interest, as it forms a valuable contribution to our knowledge of this subject. Mr. Webb has evolved a graphical method of solution for non-cylindrical shafts, in which a graph of $\sqrt{I/w}$ is drawn for the shaft, w being the weight per unit length, and I the moment of inertia of the section in bending. The whirling speed can then be estimated roughly from a set of typical curves included in the paper, or can be calculated by employing graphically Mr. Webb's two formulæ. For the purpose of checking the new method, a number of new solutions has been found by rigorous mathematics. These cases include a cylindrical shaft, a solid shaft consisting of one or more conical pieces, a hollow shaft with all its weight in the rim, and consisting of one or more conical pieces, and a solid shaft the meridian curve of which consists of one or more parabolic arcs, all of them, produced if necessary, touching the axis. For all cases the agreement is remarkably close, and shows that the new graphical method is valid if (maximum value of Iw)/(minimum value of Iw) is less than 40,000, which limit probably includes all shafts likely to be required in practice. Mr. Webb's method is based on a hitherto unpublished approximate method of attacking the general problem devised by Mr. W. H. Barling some years ago. Mr. Barling's hypothesis is that there is no transference of energy between consecutive elements of the shaft, and it gives correct results for cylindrical shafts.

MESSRS. J. M. DENT AND SONS, LTD., will shortly publish "A Complete System of Nursing," by Miss A. M. Ashdown. It is claimed for the work that it will contain all the practical information which a nurse may require during her training and in actual practice.

MESSRS. DULAU AND CO., LTD., 37 Soho Square, W.1, have just issued a valuable and interesting catalogue (No. 69, November) of more than 1600 works on Botany (Phanerogams and Cryptogams), Zoology (Vertebrates and Invertebrates), Herbals, Gardening, and Agriculture. Many of the books offered for sale are rare, and a considerable proportion, being of foreign origin, are difficult to obtain in a new condition at present. The catalogue should be of service to many of our readers.

IN the article on "Ferro-Concrete Ships" which appeared in last week's NATURE, it should have been stated that we were indebted to *Engineering* for the blocks with which the article was illustrated.

OUR ASTRONOMICAL COLUMN.

ORBITS OF COMETS.—The orbits of three comets are discussed by S. Ogura in *Annales de l'Observatoire Astronomique de Tokyo,* tome v., part 3. (1) Comet 1827 II. was discovered by Pons on June 20, 1827, and observed by him for a month; Pons used a ring micrometer, and his observations show rather large residuals. The definitive orbit is as follows:—

$$T = 1827 \text{ June } 7{\cdot}192422 \text{ G.M.T.}$$

$$\left.\begin{array}{l} \omega = 19^\circ\ 18'\ 56{\cdot}12'' \\ \Omega = 317^\circ\ 39'\ 39{\cdot}67'' \\ i = 136^\circ\ 26'\ 11{\cdot}00'' \end{array}\right\} 1827{\cdot}0$$

$$\log q = 9{\cdot}9067087$$

$$\log e = 9{\cdot}9774915$$

$$\text{Period} = 63{\cdot}83 \text{ years}$$

The period is considered to lie between fifty-nine and sixty-nine years. The orbit of the comet of 1500 shows a distant resemblance, but identity is improbable.

(2) The comet of 1132 was observed in Japan on October 5, 7, and 9; its motion was extremely rapid, 100° being described in four days. The following orbit is deduced:—

$$T = 1132 \text{ August } 30{\cdot}20 \text{ G.M.T.}$$

$$\left.\begin{array}{l} \omega = 114{\cdot}3^\circ \\ \Omega = 201{\cdot}1^\circ \\ i = 106{\cdot}4^\circ \end{array}\right\} 1132{\cdot}0$$

$$\log q = 9{\cdot}8666$$

These elements indicate a near approach to the earth, the distance being 0·045 on October 7. This comet was also observed in China and Europe, but the positions are less precisely defined than in the Japanese record.

(3) The comet of 1240 was observed with considerable precision in Japan; it passed close to Jupiter, and the head was stated to be "as big as Venus." The following orbit is deduced from the Japanese and Chinese observations:—

$$T = 1240 \text{ January } 21{\cdot}06 \text{ G.M.T.}$$

$$\left.\begin{array}{l} \omega = 331{\cdot}3^\circ \\ \Omega = 124{\cdot}5^\circ \\ i = 75{\cdot}4^\circ \end{array}\right\} 1240{\cdot}0$$

$$\log q = 9{\cdot}8246$$

The minimum distance from the earth was 0·36 on February 2. The orbit somewhat resembles that of comet 1863 IV.

THE IRON ARC AS A SOURCE OF STANDARD WAVE-LENGTHS.—Previous investigations have shown that the wave-lengths of many of the lines in the spectrum of the iron arc, which is in such frequent use as a source of standard wave-lengths, are subject to variations depending upon proximity to the electrodes. The possible elimination of this "pole-effect" has been the subject of an important investigation by Messrs. St. John and Babcock (*Astrophysical Journal,* vol. xlvi., p. 138). It has been shown that the effect disappears in the case of the Pfund arc *in vacuo,* and becomes negligible in a narrow central zone of the same type of arc in air when the negative pole is of carbon. The former, however, is not a convenient everyday source, and the latter is lacking in intensity. The practical outcome of the extensive experiments is to show that a Pfund arc, with both poles of iron, may be relied upon to give the "fundamental" wave-lengths of even the most sensitive lines, if the length of the arc be not less than 8 mm. and the current not more than 5 amperes; under these conditions a horizontal zone near the centre at least 1¼ mm. wide may be used with safety. This arc also has the advantage of giving sharply defined lines, and uniformity in the relative intensities. The investigation has shown that the pole effect has not been entirely eliminated in the case of the adopted international standards, and that certain supposed anomalous displacements of iron lines in the sun become normal when the fundamental wave-lengths of such lines are used for comparison.

CAPE OBSERVATORY REPORT.—The report of his Majesty's Astronomer at the Cape of Good Hope for 1916 has been received. Besides work of a more or less routine character, we note that a new programme of observations of close circumpolar stars with the reversible transit-circle has been undertaken, with special reference to the determination of the constant of aberration. Mr. J. Voûte has completed his series of observations for stellar parallaxes by means of right ascension measures, and has also made observations of double stars. The programme of observations for radial velocities of stars with the Victoria telescope and four-prism spectrograph was completed before the end of the year, and experiments with a shorter camera are in progress with a view to the extension of the observations to fainter stars. Photographs of the sun, intended to supplement the Greenwich series, were